

In the Hon. Walter Rothschild's beautiful collection of New Zealand birds at Tring Park there are two partial albinos of this species. They are male and female. The former has the crown of the head, face, throat, and an irregular narrow stripe down the fore-neck dull greyish-white; on the shoulder, breast, and back there are likewise a few scattered feathers of pure-white. The female, which is an exceptionally large specimen, has a broad, irregular, transverse band of yellowish-white on the under-part of the body; rest of the plumage normal.

From a fresh specimen I obtained the following measurements:—*Adult* ♀. Length, to end of tail 29in., to end of outstretched legs 41in.; culmen, from anterior edge of cere to the tip, 5·25in.; along the edge of lower mandible, from the angle of the mouth, 6·25in.; tarsus, 3·50in.; middle toe and claw, 3·50in. (the claw being 1in.); hallux, 0·75in.; median circumference of tarsus, 2·50in.; circumference at junction of phalanges, 4·25in.; humerus, 2in.; cubitus, 1·50in.; spur, 0·25in.

ART. XI.—*On the Fissures and Caves at the Castle Rocks, Southland; with a Description of the Remains of the Existing and Extinct Birds found in them.*

By A. HAMILTON.

[Read before the Otago Institute, 10th May, 1892.]

Plates VII., VIII.

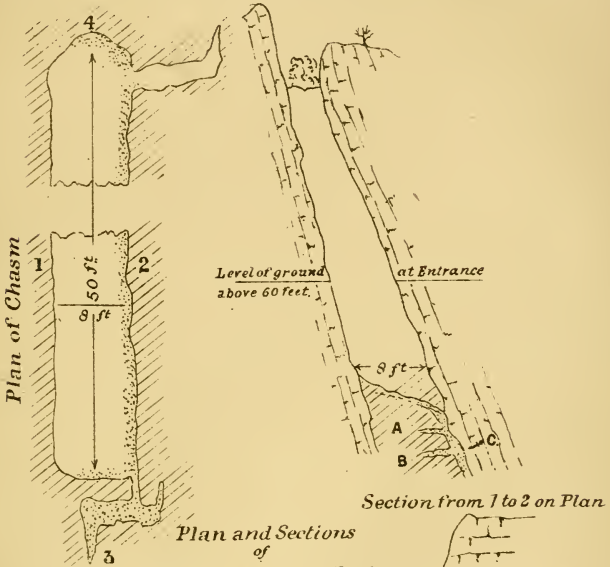
A FEW miles south of Lumsden, on the right bank of the Oreti River, Southland, an outcrop of limestone occurs at a place called the Castle Rocks. Here denudation has exposed the beds of limestone, which are tilted at a high angle, and huge masses of rock have become detached, and have fallen, slipped, or rolled to a resting-place on the spurs of the steep hillsides or down to the valley beneath. The enormous size of the blocks, and the confusion in which they are piled, recalls many a memory of ancient and picturesque ruins on historic sites.

In this part of the world we are but now making history, and comparatively little of Nature's record of past centuries has yet been read. Hidden in these Castle Rocks my friend Mr. Mitchell and I have been privileged to find a very interesting, even if still imperfect, chapter of the unwritten record of the past.

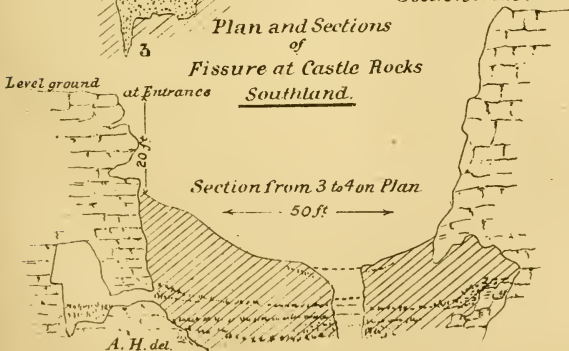
For convenience I shall use the first person in writing these notes; but it must be understood that Mr. Barnhill, of the

BONES IN FISSURE CAVES

To illustrate Paper by A. Hamilton.



Plan and Sections
of
Fissure at Castle Rocks
Southland.



A. H. del.

Castle Rocks Station, and Mr. Mitchell, of Manipori, have co-operated with me and rendered me every assistance in the exploration of the caves, and that I am deeply indebted to them for their help.

Mr. Mitchell having found some bones of *Aptornis defossor*, Owen,* in some caves amongst these rocks some years ago, I was induced to visit the place, and, after some little search, found that there were two places which yielded small bones of birds other than moa. One place was at the bottom of a deep water-worn cave, far down under the rocks, the bottom of which was a stiff, yellow, wet clay; and the other, a more promising-looking place, nearly on the top of a hill, was a naturally-formed trap or pitfall for apterous birds. The descent into this pit was perhaps 25ft. or 30ft. Small trees and bushes were growing close to the mouth, and a long vine or stem of the *Rubus* served as a rope by which to descend into the pit or chasm. The greater part of the floor was covered with a stiff, greasy-looking brown earth, somewhat irregular on the surface, and in many parts hidden by the dead leaves, dry twigs, and sticks that had fallen or blown into it. I was surprised to see sticking out from the *débris*, under the sloping surface of the rock on the lower side, a number of bird-bones, and still more surprised and delighted to find that, by scraping up the ground with a pick, bones could be obtained in great numbers. I must now try to describe more particularly and definitely the character of the chasm or fissure.

The sides were formed by two enormous blocks of the limestone imbedded on their edges, with the planes of stratification or fracture nearly parallel, but both tilted at a considerable angle. The upper end of the chasm was closed by irregular blocks of limestone, and also the lower end, but not to the same level. The chasm is only accessible from this lower end. The length was about 50ft., and the average breadth 8ft. The rock on the right of the entrance sloped at a somewhat greater angle than the one on the left, so that the width increased a little towards the bottom.

A reference to the plan and sections on Plate VII. will give an idea of the place.

The general result of the digging in this pit was that the bones were only found along the underface of the rock on the right hand, and chiefly in the light friable mould formed by the decay of the leaves and vegetable *débris*; and this, mixed with the limestone dust and efflorescence, proved to have preserved even the most delicate bones in perfection. On the left-hand side the soil was stiffer, and full of bird-guano and clay; very few bones were found in it. A reference

* See Trans. N.Z. Inst., vol. xx., p. 175.

to the section will show that at A and B there were two distinct layers of guano thickly studded with the smaller bird-bones, and much hardened and consolidated, possibly by the trampling of birds. The space marked C, as mentioned above, contained the best bones, but all in the greatest confusion: only in a few instances did we obtain anything like a complete skeleton of any bird with the bones in approximation.

On our last visit we went to a depth of 8ft. at C, and got bones in profusion. Much as I wished to do so, we found it impossible to go deeper, as the earth above would keep coming in on us. At D we found a hollow, or open shelter, which was almost if not quite closed with the accumulated earth. A large number of bones were got from this part.

At E, some little distance under the surface, Mr. Mitchell found a crevice which appeared to lead into another cave. The prospect of a new and untouched deposit fired us with the greatest enthusiasm, and we dug the soil away till the aperture appeared; but, alas! it was only 9in. wide at the mouth—much too narrow for either of us to squeeze through. Placing a lighted candle on the end of a long stick we pushed it in and saw a cave, not very large, but very pretty, as the floor was thickly covered with bird-skeletons all covered with the pure-white efflorescence from the limestone roof, like snow. Great expectations were formed as we took it in turns to hammer at the narrow opening with my geological pick, and, after more than an hour's work and numerous trials, Mr. Mitchell, being an inch or so less than I, managed to wriggle in on his side. He then gathered up the bones and passed them out to me, literally in "hatfuls."

The floor of the short passage, which widened a little after the entrance, was very hard, as if trodden down by the passage of birds.

The end of the little cave was a small irregular chasm, descending vertically, which was too small to examine properly.

At F, at the other end of the cave, there was another lateral opening, 10ft. or 12ft. high at the mouth, and extending perhaps 20ft. This was covered on the floor with soft crumbly stalagmitic deposit, but no bones were found in it.

As the result so far of our examination, I find that, of still-existing birds of flight, a considerable number of species are represented, but naturally only in small numbers. They include owls, hawks, crows, petrels, and some of the smaller perching-birds. The distinct group of birds which we call in general terms moas was well represented by the species living in that part of the country, and some excellent skeletons of some of the smaller species were obtained, and some instructive specimens of immature birds, which promise to yield interesting information on obscure points.

The character of the deposit was such that our examination of it was necessarily slow and minute, the bones being found in such a confined space: it is therefore somewhat surprising that not a single fragment of eggshell of any kind whatever was found by us. In the Earnsleugh cave, I believe, numerous fragments were found both of duck and moa eggshell.

The bones themselves were exceptionally well preserved, only two small patches being found where the bones were perished through damp.

The scattered condition of the bones of the smaller birds may, I think, be accounted for by the probability that wekas (and kiwis) lived for some time after their being entrapped—as long as there were dead birds, or weak individuals which might be killed, on which they could live.

To account for the male and female of the giant eagle (*Harpagornis*) being present is almost as difficult as to account for their presence in all the large finds of moa-bones. They may have had their nest on the top of the rock, and it is quite possible that they may have been tempted in by the carcass of a dead moa, and then have found that in the narrow space between the rocks they were unable to spread their wings for flight, and thus perished miserably.

In all open fissures or chasms of this kind we may expect to find intrusive deposits: I was therefore not surprised to find the bones of a sheep at and near the surface; also, at a lower depth, close to the rock, the skull and remains of a polecat ferret;—no doubt accidental victims during the “sheep period.” No trace of man’s handiwork was found, either in the form of stone tools or of intentionally-broken bones. Some of the bones near the top of the leafy deposit at C had been slightly burnt—in all probability from sparks from the frequent grass-burnings in the neighbourhood, or from the matches of visitors at an earlier date than our exploration.

From inquiries I find that this place has been known for many years to settlers in the neighbourhood, rabbiters, and others, and that numbers of the most noticeable bones have been collected at various times, but not preserved. It is difficult to express one’s feelings on this matter, and I deeply regret that the specimens have all perished, as from what we found remaining it is probable that almost priceless treasures have been destroyed heedlessly. Mr. Savage, who was my guide on the first occasion, collected a number of bones some years ago, and transmitted them to a museum in Scotland. To his intelligent interest in the matter I owe much valuable information. I have undertaken to examine and report upon the very large number of bones which the chasm yielded to our digging, and I now propose to give a short account of the most

important of the species at present recognised among the remains.

HARPAGORNIS.

Pride of place will certainly be yielded to the great extinct eagle, first made known by the excavations of Sir Julius von Haast at Glenmark, and described by him twenty-one years ago (1871). Very few bones have since been found, except at Hamilton Swamp and Enfield. I was therefore much pleased when I found very near the surface the ulna of *Harpagornis*, and shortly after one of the huge claws, or unguis phalanges. Piece by piece we found most of the important bones of the body, and on the last day of our digging we found the long-looked-for skull, nearly perfect. Up to the present time only two very much broken crania have been found—one at Motunau, and the other, rather more perfect, at Enfield. Strangely enough, none of the bones found were duplicates, till just at the last a second right coracoid, much larger than usual, was found, thereby implying the presence of two skeletons, and giving hope that further research will be rewarded.

Harpagornis moorei, Von Haast.

Skull.—Fragments known:—

1. Basal portion, much broken, from Motunau, North Canterbury; in Colonial Museum, Wellington.*
2. Fairly perfect calvaria, from the deposit of bones exhumed by Mr. H. O. Forbes at Enfield, near Oamaru, Otago, 1891.
3. Skull and upper mandible, nearly perfect, with right quadrate, from Castle Rocks, Southland.

There is a lower mandible of *Harpagornis* in the Christchurch Museum, from the Hamilton Swamp. From its measurements I should assign it to *H. assimilis*. Extreme length, 113mm.; extreme width at articulation, 74mm.

Vertebrae.—From Castle Rocks:—

- Cervicals, 4.
- Dorsals, 6.
- Caudals, 3.

Pelvis.—From Castle Rocks: Length, 7·27in. (180mm.); greatest breadth, 3·25in. (75mm.).

The pelvis in the Colonial Museum is from Otago, and was found by Mr. Low.† It measures 7·22in. in length, and 3·38in. in width. The specimen has been figured by Haast and by Owen.

* Rep. Geol. Surv. N.Z., 1883, p. xx., and p. 76.

† Trans. N.Z. Inst., vol. iv., p. 114 (footnote); Trans. N.Z. Inst., vol. vi., p. 71, pl. ix., figs. 1, 2, 3. Owen, "Extinct Birds of New Zealand," vol. ii., pl. cv., figs. 1, 2, 3.

H. assimilis: A fragmentary pelvis is recorded in the Transactions* as having been found at Glenmark, and is one of the types in the Canterbury Museum. The extreme length of the sacrum is 122mm. It is too much broken for further measurements. The sacrum of the Castle Rocks specimen measures 136mm.

Sternum.—Mr. Forbes has had, I believe, the pleasure of discovering this bone at Enfield.

Coracoid.—Two specimens of this bone were found at the Rocks, and, being both from the same side, indicated the presence of two birds.

1. Total length, 106mm.; greatest width at base, 52·5mm.
2. " " " 90mm.; " " " 50mm.

As the coracoid of the smaller sex of *Harpagornis* has not yet been recorded, we may for the present assign No. 2 to *H. assimilis*, which is in all probability, as suggested, the male of *H. moorei*. Should, however, a still smaller coracoid occur, the determination will be doubtful, and the difference will only be of an individual character.†

Scapulæ.—The right and left scapulæ were obtained in the course of the excavations at Glenmark.‡ These were, I believe, of *H. moorei*, as on p. 63 the left scapula of *H. assimilis* is mentioned as part of the result of further excavation. No measurements are given of these.

At the Castle Rocks the right and left scapulæ were found of what I take to be *H. moorei*. The extreme length in a right line is 134mm.

Furculum.—The specimen I found I unfortunately broke with the pick, and though I searched carefully I could not find the remaining portion. The fragment shows the very robust character of the bird. The bone has not been recorded before. There is, however, a cast of a fragment of a furculum in the Canterbury Museum; the locality of the original is unknown—possibly Enfield.

Humerus.§—A very perfect humerus was found in the stiff brown earth at the upper part of the cave. It measures: length, 240mm.; circumference, 55mm. This is probably the humerus of *H. moorei*, as the humerus of *H. assimilis* is given as 223mm. (8·57in.). I have examined the types in the Canterbury Museum, and I make the measurement

* Trans. N.Z. Inst., vol. vi., pp. 66, 71, and 73.

† There is a cast of a coracoid in the Canterbury Museum, locality unknown—possibly Enfield—measuring 84mm. This might also be of *H. assimilis*.

‡ Trans. N.Z. Inst., vol. vi., p. 62.

§ Trans. N.Z. Inst., vol. iv., p. 195: fragment of right humerus, Glenmark Creek. Owen, "Extinct Birds of N.Z.," p. 145. *H. assimilis*: Trans. N.Z. Inst., vol. vi., p. 69, pl. viii., figs. 1, 2 (lettered in error *H. moorei*). Owen, "Extinct Birds of N.Z.," pl. cvi., figs. 1, 2.

216mm., or 8·42in. Besides this bone there are two fragments, one of the distal end of a humerus and the other of the proximal end, in the Canterbury Museum.

Ulna.*—This bone was also found perfect at Castle Rocks. Its length was 259mm., which is nearly the same as the right and left from Glenmark—10·06in., as given in the Transactions.

Having recently measured the type specimens in the Canterbury Museum, and some from Enfield and Hamilton, I give the dimensions:—

H. moorei.

	in.	mm.	
Glenmark, R., type, mended, length	9·9	250	Cant. Mus.
" L., "	9·9	250	
Hamilton, R.	9·0	255	Otago Univ. Mus.
Castle Rocks, R. .. ..	..	259	

H. assimilis.

Glenmark, L., type†	..	..	9·25	232	Cant. Mus.
" R., " .. ..	..	..	9·3	235	"
Hamilton, R. .. ..	..	..	9·0	230	"

Radius.‡—Found on the surface, at the extreme end of the cave, under the overhanging rock. Length, 246mm.

There is a radius in the Canterbury Museum from Enfield measuring 235mm. These two will probably belong to *H. moorei*.

The type of *H. assimilis* is given in the Transactions as measuring 7·62in. (Trans. N.Z. Inst., vol. vi., p. 71), but from my measurement I make it 8·6in., or 219mm.

Metacarpus.§—One perfect metacarpus was obtained, and, as it measures 126mm., it will probably belong to *H. moorei*, the metacarpal of *H. assimilis* being given as 4·48in. (about 105mm.); I find the type, however, to measure 113mm.

Carpus.—I found a small bone, which I take to be the carpus, when sorting over the smaller fragments from the cave.

Femur.||—Unfortunately we have not yet found in the cave a femur of *Harpagornis*. Von Haast gives the length of the femur of *H. moorei* as 6·66in. (166mm.); Glenmark.

* Trans. N.Z. Inst., vol. vi., pp. 62, 63, 70. *H. assimilis*: Trans. N.Z. Inst., vol. vi., pp. 63 and 70, pl. viii., figs. 3, 4. Owen, "Extinct Birds of N.Z.," pl. cvi., fig. 3, p. 145.

† The left ulna of the type of *H. assimilis* is slightly abnormal at the distal end.

‡ Trans. N.Z. Inst., vol. vi.: fragment of left radius. *H. assimilis*: Trans. N.Z. Inst., vol. vi., p. 71, pl. viii., figs. 5 and 6.

§ Trans. N.Z. Inst., vol. vi., pp. 63, 64, 71, pl. viii., fig. 7. Owen, "Extinct Birds of N.Z.," p. 146.

|| Trans. N.Z. Inst., vol. iv., p. 193, pl. x., fig. 1: left femur. "Geology of Canterbury and Westland," p. 444. Broken femur in bed 5, peat, Glenmark: Trans. N.Z. Inst., vol. vi., pp. 64, 65.

H. assimilis:* A right and left femur were found in the deposit of the Glenmark Creek, and the measurement is given at 6·09in. (146mm.). I make it 155mm. There is a femur of *H. assimilis* in the Otago University Museum, from Hamilton, which measures 147mm.

Tibia.†—Only one tibia was recovered, but that was in most perfect preservation. It is slightly longer than the Glenmark specimen, being 249mm. The right and left of both species seem to have been found at Glenmark (pp. 62, 63). These specimens measure 9·3in. (or 236mm.) and 9·4in. (or 239mm.). The same bone in *H. assimilis* is 8·92in. (227mm.) in length. In the type of *H. assimilis* the articulating surface is too much destroyed to allow of accurate measurements being obtained; the length is, however, approximately correct. A specimen from Hamilton, also in the Canterbury Museum, more perfect, but still wanting a process, measures 8·25in. (210mm.).

Fibula.‡—Two fibulæ were found, one much broken. Those found at Glenmark are supposed to be of *H. moorei*.

Metatarsus.§—One right metatarsus was found at the Rocks. It measures 162mm., being slightly longer than the Glenmark type, 6·08in. (155mm.). The breadth at proximal end is 40mm.; at distal end, 44mm. I have a specimen from the Dunstan Range measuring 158mm., and one from the Maori middens at Warrington, 137mm.: this latter, however, will be probably *H. assimilis*,|| which Von Haast gives as 5·87in. (150mm.).

Metatarsus of H. moorei.

Length.	—Breadth.—		
	prox. end.	distal end.	
mm.	mm.	mm.	
Glenmark types 155	37	42	2 specimens, R. and L.
Castle Rocks ... 162	40	44	
Dunstan ... 158	38	43	
Enfield ... 155	38	42	Cant. Mus., R.

Metatarsus of H. assimilis.

Glenmark type 148	32	37	Cant. Mus.
Hamilton ... 148	31	37	"
Warrington ... 137	30	36	"

* Trans. N.Z. Inst., vol. vi., pp. 63, 65. Owen, "Extinct Birds of New Zealand," p. 146, pl. cvii., figs. 1, 2.

† Trans. N.Z. Inst., vol. vi., pl. vii., figs. 1, 2, p. 66. Owen, "Extinct Birds of New Zealand," p. 147, pl. cvii., figs. 5, 6.

‡ Trans. N.Z. Inst., vol. vi., pl. vii., figs. 3, 4, pp. 62, 67.

§ Trans. N.Z. Inst., vol. vi., pl. vii., figs. 5, 6. Owen, "Extinct Birds of New Zealand," p. 147, pl. cvi., figs. 5, 6.

|| Trans. N.Z. Inst., vol. vi., pp. 63, 64, 70.



Phalanges.*—Those recovered were four ungual phalanges,† and most of the bones of one foot.

Ribs.‡—About fifteen ribs, more or less perfect.

Passing over the remains of still-existing flying-birds, a list of which will be given at the end of this paper, we will next take a very important group of Ralline birds in which the power of flight is feeble, if not altogether lost, and which contains some of the most interesting forms included in the New Zealand ornithology.

NOTORNIS.

One of the forms which some of us have been permitted to see in the flesh is *Notornis mantelli* of Owen, or *Notornis hochstetteri* of Meyer, otherwise known as the takahe. Perhaps it is the fact that we have actually evidence, from living specimens, of its plumage and appearance, that gives it quite a popular interest, to say nothing of the actual value as a museum specimen.

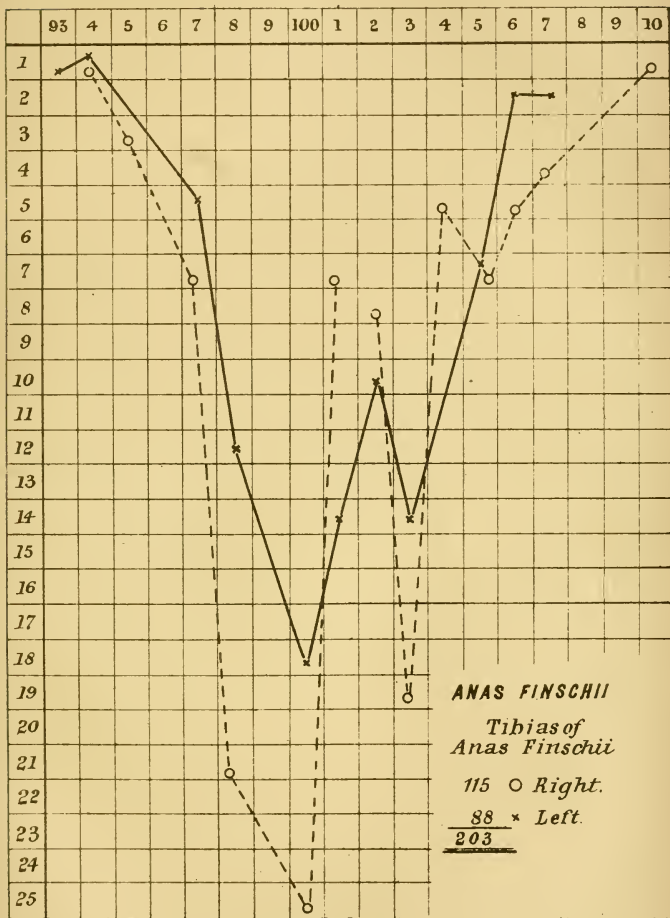
The cave yielded the remains of three of these birds, two of the skulls and the set of limb-bones being nearly complete, one of the skulls being in an exceptionally fine state of preservation.

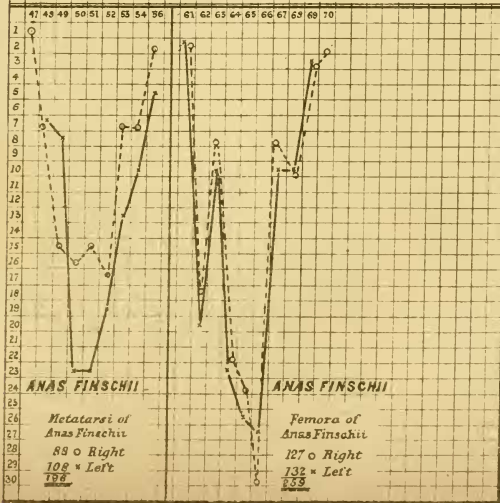
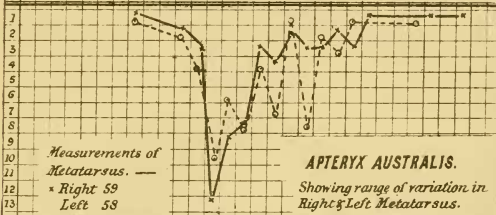
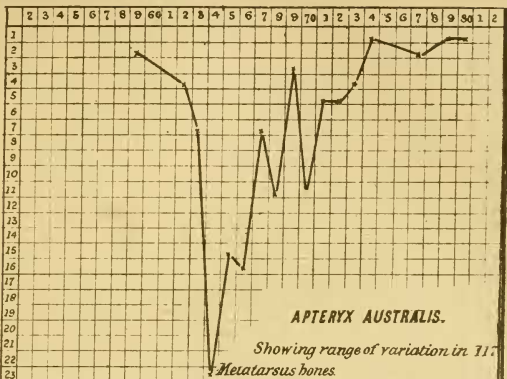
I have given a table of measurements below, by which it will be seen that the measurements of the principal bones closely agree with those of Von Meyer and Professor Parker, and differ largely from Professor Owen's Waingongoro specimens, thereby supporting the idea that there must have been some error in the determination of some of the type bones, or that the North Island species is much larger. The only remains that I obtained at Te Aute correspond more nearly with the southern bones than those of Waingongoro. The measurements of any bones from the original locality in the North Island would be of great interest. Recently I obtained three metatarsals from a Maori midden at Longbeach, near Dunedin, which fact would perhaps indicate that at one time this stately bird was not uncommon, and was valued as food. A

* Trans. N.Z. Inst., vol. vi., pp. 62, 175. Casts of the type bones of *Harpagornis* are in the British Museum, and are mentioned in Lydekker's Catalogue, 1891. The only original bone at that date in the Museum collection was one from Waingongoro, in the North Island of New Zealand: "the proximal phalangeal of the second digit of the right manus" (No. 32245h). On page 26 the notice of the original types states that they are in the Museum at Wellington. The pelvis of *H. moorei* is the only one of the types in the Colonial Museum; the rest are in the Canterbury Museum.

† Trans. N.Z. Inst., vol. iv., p. 195, pl. xi., figs. 1, 2. Trans. N.Z. Inst., vol. vi., pp. 62, 63, and 75. Owen, "Extinct Birds of New Zealand," p. 148, pl. cvii., fig. 7.

‡ Trans. N.Z. Inst., vol. iv., p. 194, pl. xi., fig. 5. Trans. N.Z. Inst., vol. vi., pp. 62, 63.







Harpagornis moorei.
(lower view.)



Harpagornis mocreii.
(side view.)

